

ANCAP FUTURE TECHNICAL DIRECTIONS

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Paper Number 470

ABSTRACT

ANCAP has reviewed international crash test programs to see how to upgrade the occupant safety information, within the available budget for procuring, testing and assessing new vehicles. A summary of present world NCAP consumer information is presented. ANCAP's future strategy during the next decade will require decisions on which of the present NCAP harmonised crash tests continue to be used. Reasons for change are discussed to reduce injury to vehicle occupants in serious crashes.

Differences in the roles of crash avoidance and occupant protection in contributions to vehicle crashes have not been addressed in present ANCAP information packs. Information in a simple format that includes pre-crash items that may prevent the crash in addition to the occupant injury received in a crash has been identified as worthwhile to consumers who are looking for a safe new vehicle. A method to add pre-crash information to ANCAP assessments is suggested, together with the type of equipment effective in pre-crash safety. Unfortunately, there is limited available research on effectiveness of pre-crash equipment. Preliminary methods that could make this information available to consumers in a simple format are presented.

INTRODUCTION

Buyers of new vehicles are becoming accustomed to seeking information on the safety of prospective new vehicles in the market. They have experienced various NCAP publications through the media, and specific safety material published by the vehicle manufacturers. Some buyers may be searching for the safest vehicle available or for a vehicle in the top safety group. Other buyers may be interested in child safety if they have small children that will be travelling in the vehicle. They wish for accurate and informative safety information. NCAP managers and providers have a need to continuously seek to provide more relevant and informative safety information.

With NCAP published results now available on the Internet from the USA, Japan, Europe and Australia the consumer has considerable choice.

The basis for the information provided by these international NCAP consumer-testing programs in 2003 is shown in Table 1. Each NCAP group purchases, tests and assesses vehicles to their own procedures to give consumers comparative occupant safety information. Under current programs, no attempt is made to assess the safety of the vehicle from crash records, or from the vehicles ability to avoid the crash in the first place (other than braking tests conducted by JNCAP).

Safety Information From Hospital Admissions

Some motoring and safety organisations publish information on the hospital admissions per 100 crashes of particular models of vehicle. The criteria for hospital admission is seen as a breakpoint to separate reasonably serious injuries from cuts and scratches that can be treated by a doctor where the driver or passenger in the crashed vehicle recuperates at home. This information is not available for a new model in the first or second year it is available in the market because the accuracy may be questionable due to insufficient crash exposure. When the information is published consumers may be faced with different rankings of vehicles to those in an NCAP test result. This difference may exist as the NCAP ratings only consider a few of the most common crashes: an offset frontal crash, a side impact crash and in some programs a sideways crash into a pole. Hospital admission crashes would include rear end crashes that resulted in neck injuries, the most common crash injury not presently assessed by NCAP tests. Another major reason for differences in the two program results is the weighting of minor injuries from the hospital data that are treated at the hospital when the injured person is admitted for observation reasons.

PRIMARY SAFETY EQUIPMENT AND NCAP ADVICE

Crashes have many causes and some could be avoided if the driver took advantage of vehicle attributes or systems that are now available to avoid an imminent crash.

So far NHTSA (USA NCAP) has two safety equipment lists, one is for airbag safety features (Table 2), while the other is for primary safety features (Table 3).

Table 1.
International NCAP Testing Programs in early 2003

ORGANISATION	Frontal Testing method	Side testing Method	Pole Testing method	Pedestrian testing method
Japan NCAP Organisation for Automotive Safety & Victims Aid (OSA)	Full frontal test at 35 mph (56kph) Offset frontal test at 64kph	90 degree ECE type test at 55 kph	No test	No test
USA NHTSA	Full frontal at 35mph (56kph)	27degree crabbed test at 38.5mph	No test	No test
USA through IIHS	Offset frontal test at 64 kph	Development of new barrier	No test	No test
Europe through EuroNCAP	Offset frontal test at 64 kph	90 degree ECE type test at 50 kph	29 kph vehicle into pole, head injury evaluation	Child &, Adult head impact at 40kph on bonnet. Upper & lower leg impacts on front of vehicle.
Australia ANCAP	Offset frontal test at 64 kph	90 degree ECE type test at 50 kph	29 kph vehicle into pole, head injury evaluation	Child &, Adult head impact at 40kph on bonnet. Upper & lower leg impacts on front of vehicle.

Table 2.
USA NCAP Airbags Safety Feature Availability (web 2003)

Make	Model	Advanced airbag feature	Side airbags front	Side airbag rear	Head airbag	Head injury protection	Rear seat head restraint	Dynamic Head Restraint
Toyota	Corolla	x	Option	x	x	x	✓	x
Honda	Accord	✓	Option	x	x	Option	x	x
Saab	9-3	✓	✓	x	✓	✓	✓	✓
DBenz	EClass	✓	✓	✓	✓	x	✓	x

✓ Means the feature is standard fitment, X means not available and Option means buyer choice.

In addition NHTSA publishes an informative paragraph for readers on the safety value that the listed features provide, see table 3.

Table 3.
NHTSA Primary Safety Information

Japan NCAP publishes a combined list of features covering airbags, seatbelts, brakes and child restraints; see Table 4, for each vehicle model.

EuroNCAP list some features in a brief note on each detail sheet listed on the web site, see Table 5.

ANCAP provides airbag fitment details to test vehicles.

In tables 2,4 and 5 a few popular vehicles are shown with the features available.

Vehicle Systems to Reduce Crash Risk	
4 wheel ABS	Adjustable upper belts front & rear
Electronic Traction Control	Pretensioners
All wheel drive	Energy Management
Automatic Crash Notification	Integrated Seat
Auto-Dimming Rear View Mirrors	Rear centre Shoulder belts
Daytime Running Lights	Child seat lower anchorages

Table 4
Safety Feature Availability in JAPAN (2002)

Model	Grade or Type	Airbags	Seatbelts	Brake	Child Seat
Manufacturers name	Grade or model name that has the feature	Driver/ Passenger / Side	Adjustable anchors/ Pretensioners/ Seatbelt force limiters	ABS/ Brake Power assist device	Seatbelt with a child seat locking mechanism / Integrated Child Seat / Common fixture (ISOFIX) seats
Toyota Corolla	All	✓ ✓ x	✓ ✓ ✓	✓ ✓	✓ x ✓
M Benz E Class	All	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	x x x
Saab 9-3	All	✓ ✓ ✓	✓ ✓ ✓	✓ x	✓ option ✓
Honda Accord	All	✓ ✓ x	✓ x ✓	✓ ✓	✓ x x

Table 5.
Euro NCAP List Of Features (web 2003)

Model	Driver & Passenger airbag	Side airbag	Curtain Airbag	Seat Belt pretensioners	Load limiters	Seat Belt reminder	ISOFIX
Corolla	✓	x	x	✓	✓	x	✓
Honda Accord (1999)	✓	✓	x	✓	✓	x	x
Saab 9-3 (2003)	✓	✓	✓	✓	✓	✓	✓
D Benz E Class	✓	✓	✓	✓	✓	✓	x

Primary (Active) Safety Features

To date no NCAP program scores the primary safety features or rate the ability of the feature in its crash avoidance capability, although JNCAP presents the results of its braking tests (described later). A primary safety evaluation system should function as a reliable guide for new vehicle buyers who are looking for good safety features. The evaluation system of these primary safety features needs to consider the wide spectrum of crashes, collision objects, crash severities and injuries, which are likely to be found on roads. In some countries the road conditions can vary considerably from region to region which could alter the usefulness of the feature to reduce the likelihood of a crash.

Discussion A literature search failed to locate technical papers that rank safety features that are available in many vehicles in the market for consumers to choose that would assist a driver to avoid a crash. As an example, no information was found to rank traction control as likely as ABS brakes to assist a driver to avoid a crash. There is little information available to score or rate the

difference of these two worthwhile safety features. One system lets the driver steer while braking hard, while the other can prevent the driver from losing control. NCAP marketing has so far only presented data on primary safety system availability and general information to consumers in this important area of buyer choice on overall safety information at the time of vehicle purchase.

A Rating System for Primary Safety Features on Vehicles

The objective for scoring must be to provide knowledgeable information to consumers, based on injury reduction benefits likely to accrue to vehicle occupants. Manufacturers already use assessment tests to evaluate a primary safety feature from one supplier against a similar feature from another supplier or competitive vehicle to support installation of the feature in a particular vehicle. How the evaluation considers injury reduction in the wide variation of crash situations may be different from one manufacturer to another. Clearly close liaison between manufactures researchers and NCAP teams is likely to be a constructive way forward in developing a reasonable assessment

protocol for rating primary safety items. Until this has taken place, it is ANCAP's view that scoring one manufacturer's primary safety device to improve crash avoidance against another's is premature. This evaluation could be called the device effectiveness score, and form one of the elements in scoring the ability of the device to reduce road trauma. See Table 6.

It is also essential for crash researchers to consider the relative incidence and injury severity of different types of crashes before a scoring system could be effectively set up. Meaningful information on each primary safety system injury severity reduction as well as incidence rate for each primary safety device are essential parts to introduce a rating system.

Table 6.
A system of scoring primary safety devices on vehicles

Device	Injury Incidence reduction	Injury Severity reduction	Device effectiveness score	Net Benefit to reducing injury of occupants
1* ABS	5%	10%	80%	9%
2* Smart Cruise Control	8%	15%	75%	10%
Total				Sum of scores

*Device and parameters for illustration purposes only

Injury Incidence reduction would come from researchers who have published reports on the expected benefits of the primary safety device in avoidance of a crash resulting in a figure of crash avoidance percent, against similar vehicles that do not have the device fitted.

Injury severity reduction is also essential data from researchers who report research that shows that the device when fitted is likely to reduce the injury severity for example from AIS 4 to AIS 2 in a percentage of crashes. This could be used to produce a score out of 100 for the severity of injury reduction.

The device effectiveness score is based on liaison with manufacturers and researchers to produce test to enable a score showing the benefits of the device over a vehicle's performance compared to a vehicle without the device installed, operating and used correctly.

The net benefits to the occupants for a vehicle for each primary safety feature is then a combination of the scores from the three inputs resulting in a score that shows the benefit of the device, in terms of injury reduction, compared to a vehicle without the device installed and operating. Totalling the scores for a vehicle with more than one safety device fitted for pre-crash performance improvement would give a result for the vehicle under consideration. This could be published to give a non-technical reader the best possible assessment of the benefits of the vehicle's pre-crash safety package.

NCAP organisations should consider vehicle primary safety features to give new vehicle buyers

greater information to allow them to make a knowledgeable choice when considering the options lists presented by manufacturers' glossy brochures in the showroom. To achieve this, NCAP organisations should assess the performance of features against standard test conditions to rate the ability of the feature to do what is intended. Consideration of primary safety features that would assist in severe cold conditions (icy roads) may not be equally desirable in crash avoidance compared to features in a warm tropical (high intensity rain) region. For this reason there may well be different ratings in different countries or international regions. Primary Safety Systems for NCAP consideration are shown in table 7.

The proposed ANCAP primary safety rating process would score the standard crash avoidance systems supplied with the base vehicle to give a primary safety rating score independent of the crash rating score. It is also proposed that brief information on the merits of each feature be provided, similar to the present NHTSA material, so the buyer would have access to an independent source of the benefits of worthwhile safety features.

Field-testing of primary safety systems would add additional time and cost to testing programs but could be achieved before the crash test vehicles are subjected to the barrier test programs. However these assessments require test procedures to be developed, test equipment to be developed and acquired, contracts for the work and technicians trained to operate the equipment correctly to obtain reliable information and then process the results. The results need to be assessed to ensure the data is useful from a vehicle safety perspective before it is

presented in a form that is useful and informative to non-technical new car buyers.

An example of one primary system test that has been carried out by Japan NCAP is the brake testing results of new vehicles all fitted with ABS. Results are published for a vehicle with driver and equipment as the load at one test speed of 100kph for both dry and wet roads. The stopping distances of the vehicle are recorded for each test. The reader is then able to evaluate the braking differences of several vehicles of interest. This gives the consumer the information to make a knowledgeable choice on braking performance.

Table 7.
Primary Safety Systems for Consideration by ANCAP

Stopping distance	ABS Braking
Electronic Brake Assist	Electronic Traction Control
Stability Control	Rear end collision warning
Smart cruise control to avoid rear end collisions	Lights that give better visibility and less glare
Lights to assist seeing around corners	Daytime running lights
Tyre pressure monitors	Seatbelt wearing warning systems
Rollover propensity rating for high seating vehicles	Speed Control
Crash monitoring event recordings	Head Impact padding zone enlargement
Head restraint & active seatbacks and head restraints	Automatic Crash Notification

ANCAP plans to review primary safety features that can assist a driver to avoid a crash and set up a separate system of evaluating and scoring the features to aid a buyer who wants to select features that can reduce the likelihood of their vehicle being involved in a crash.

SECONDARY SAFETY DEVELOPMENTS

International Harmonisation Of Tests

Where possible, ANCAP will continue to use the best international NCAP type tests for the basis of the Australian and New Zealand NCAP. This allows our small resources to be coupled to larger organisations that develop testing and assessment protocols. International manufacturers are also supportive of this approach as it is not an ANCAP intention to carry out unique tests unless there is a compelling safety and technical reason. This has

been the practice that has given Australian new car buyers information to over 75% of the volume new vehicles sold in the Australian market on individual vehicle occupant protection information.

IHRA Developments

International Harmonisation Research Activities (IHRA) are expected to play a significant role in harmonised NCAP testing methods in the future. The individual committee recommendations may take significant time to enter regulation systems, but IHRA recommendations can be incorporated quickly within international NCAP activities.

Dummy improvements are likely to be introduced as recommended by IHRA research to ensure dummy responses are more likely to represent real world injury risk than existing dummy data. ANCAP would follow changes by other international NCAP groups in changing dummy models and specifications.

There is discussion on using a 5 percentile female dummy in crash tests to ensure that smaller people using vehicles are considered by manufacturers and NCAP testing groups. Cost of adding additional tests will be a major factor in ANCAP adopting such an approach, but it is recognised that information to consumers should be more representative of the wide size differences of front seat drivers and passengers.

Deformable barrier changes are expected to better match the stiffness of intruding striking vehicles. This may result in changes to both the offset frontal barrier and side impact barrier. The test mass of the side impact barrier may also be changed as it relates to the most common representation of a striking vehicle in a particular market. IIHS work with a side impact barrier is not seen as relevant within the Australian market in 2003. Vehicles of the mass and size representative of the proposed side impact barrier are not represented in large numbers in the Australian vehicle pool. It is thought that the Australian vehicle mix that has compact 4wd vehicles as the largest growing sector in the market is different from the USA and Europe markets. This may require some special attention to select the most relevant side impact barrier face and shape in the future.

On the other hand, this could mean that some Euro NCAP test results could not be used in Australia, even though the European and Australian models were identical.

Offset Frontal Test Developments

EuroNCAP scoring system has continued to update the assessment of dummy measurements and intrusion of structure into passenger space to give a representation of likelihood of injury in an offset frontal crash. This gives ANCAP the ability to also introduce improvements to deformable barrier performance, dummy biofidelity and dummy instrumentation. ANCAP plan to continue to use the EuroNCAP offset frontal test and assessment as part of its plan to use international harmonised tests in the Australian vehicle safety information and publication program. This minimises manufacturers requirements to test unique requirements. Further changes to the offset frontal test and assessment protocols will continue to be progressively introduced by ANCAP at its next test series following introduction by EuroNCAP.

Side Impact Test Speed Increase

The present side impact test speed of 50kph remains at the speed of the ECE regulation. Both NHTSA and Japan NCAP organisations have raised the test speed above the regulation speed. The ANCAP view is the test speed should be raised above the regulation test speed to coincide with the Japan NCAP side impact speed of 55 kph. One of the reasons is the incidence of side impact injury remains high in actual crashes and the slow rate of introduction of side airbags into the Australian fleet by manufacturers compared to Europe, Japan and the USA. Several vehicles that have been tested by EuroNCAP have to be retested by ANCAP for side impact, as the model marketed in Australia is not fitted with side airbags. A date for ANCAP to commence testing with the higher test speed has not been made at this time.

EuroNCAP has made upgrades to use EuroSid 2 dummy at the end of 2002 as well as changing the deformable face of the barrier to a progressive deformation construction (Cellbond Advanced 2000). ANCAP will incorporate these changes in its side impact test during 2003.

Pole Test (Side Impact)

ANCAP has adopted the EuroNCAP method for assessment of head-protecting side airbags with the use of a pole test impact at 29 kph with assessment on head protection and satisfactory airbag deployment. It is intended to continue with the option of using the pole test for passenger cars and light vehicles meeting test eligibility requirements.

In the near future, a decision will be made about using the pole test in place of the moving barrier test, for side impact evaluation of high seating position vehicles (seat H point >700 mm) such as

some 4wd Sport Utility (SUV) vehicles. The present side impact barrier is not designed for these 4wd SUV vehicles, which allow the barrier to under ride the vehicles seating position giving a good injury score but an incomplete evaluation of the side impact injury likelihood of the vehicle. The testing and publishing of the present side impact test at 50kph for high seating position vehicles are considered to be of little value to consumers.

Child Restraint Assessment Changes

Australia has had child restraints with top tethers for more than 20 years. These are fitted exclusively to the rear seats when small children are carried. In depth crash investigations support the effectiveness of these child restraints, with minimal serious injury to the restrained children in very severe frontal and side crashes. The key requirement for child survival with low injury is minimising forward and sideways movement of the child - primarily to avoid head contacts with hazardous objects. . Australia is now receiving many new vehicles with ISOFIX fittings that, it is hoped, will reduce the likelihood of incorrectly fitted restraints in vehicles. ANCAP has reservations about the proposed EuroNCAP child restraint assessment protocol that involves scoring child dummy injury measures. There is great uncertainty about the use of the present generation of child dummies for this purpose, particularly with forward facing child seats (Paine 2003). .

Neck Whiplash Injury

Neck whiplash injury is the most reported injury in road crashes in Australia, to occupants of vehicles that have been struck from the rear. Although neck injury measurements are recorded in the offset frontal test a new test is necessary to drive change to reduce neck injury for occupants of vehicles that have been struck from the rear. This is seen as a development of the head restraint position evaluation that was used by ANCAP from 1996 to 1999 when our overall evaluation system was aligned with those used by the Insurance Institute Highway Safety (IIHS). Research Council for Automobile Repairs (RCAR) has been developing an international test that ANCAP is considering using once it has been finalised. This rating could become part of the ANCAP assessment of neck injury score in the offset frontal test or it could be a factor in the overall vehicle score and star rating.

Roll Over Test

Rollover injuries follow from the many single vehicle country road injury crashes in Australia. The rollover crash is often related to fatigue or inexperience when the driver unintentionally

moves off the side of the road, and jerks the wheel over to get the vehicle back on the road. The severe dynamic vehicle response from this unusual input means the vehicle lurches back onto the road quickly requiring other steering inputs, leading to the vehicle rolling over. Injuries are often severe, and it may be some time before help is available due to the remoteness of the crash site.

Although static rollover propensity, as is currently assessed by NHTSA, is a factor in these rollovers, ANCAP considers that the vehicle dynamic behaviour plays a significant part in the events leading up to the vehicle rolling over.

In Australia, Monash University has carried out investigations into roll overs for several years and has developed a roll over propensity test that considers the static stability of the vehicle combined with the dynamic stability performance to give a rollover propensity measure. Investigations into vehicles with above average real world rollovers and those with below average rollovers support the proposed Monash rollover propensity measures. The static stability factor now published by NHTSA is one of the inputs used in the proposed Monash rollover propensity rating. The dynamic test requires the vehicle to be driven through the ISO lane change test a number of times to measure the maximum speed at a given lateral g force that the manoeuvre can be completed without hitting the lane change marker cones. The higher the speed through the lane change, the better the dynamic stability.

Rollover propensity testing would be carried out using a vehicle that will later be crash tested, and a significant advantage is the zero damage to the test vehicle. It is felt that publishing the rollover propensity data on high centre of gravity vehicles would be more useful to consumers than just the static stability rating. The reason for not doing the evaluation on low centre of gravity vehicles such as regular sedan vehicles is their low roll over rate compared to 4wd SUV type vehicles or high seating position vehicles that are over-represented in roll over injury crashes. The cost factor is also important to ANCAP, and not doing the test on a vehicle that has low incidence of rollover is seen as a reasonable compromise.

CONCLUSIONS

ANCAP plans to move forward in developing a primary safety rating system on new vehicles to give new car buyers more safety information in a simpler format than previously available. It is expected that the primary safety information package would commence with the most common systems available on new vehicles with later

additions as testing and rating information became available. This will allow consumers to make a better-informed choice on matters affecting vehicle safety.

International harmonisation of NCAP tests is important to ANCAP and we will work with developments from IHRA and other NCAP groups to maintain equivalent test and assessment protocols as changes progressively feed in to the testing programs. This allows ANCAP to use test results from other NCAP groups. It is also important for manufacturers, who would prefer to not be dealing with different tests and assessments protocols around the world.

Two additional tests are thought necessary to ensure consumers are adequately informed of high injury incident crashes: neck injury from rear enders and head and chest injury from rollovers (particularly with high seating SUV type vehicles). Indications of the direction ANCAP will move to cover these crash types are discussed. The pole tests developed for vehicles fitted with head-protecting side airbags are seen as more relevant to injury reduction in high seating position vehicles involved in side crashes than the present side impact barrier test.

Continued development of crash tests and assessment systems within the overall international harmonisation of road safety research remains very important. ESV provides a key forum for exchange of such information.

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